Kalispel Resident Fish Project

Annual Report

1997

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KALISPEL RESIDENT FISH PROJECT

ANNUAL REPORT

1997

PREPARED BY:

KALISPEL NATURAL RESOURCE DEPARTMENT AND WASHINGTON
DEPARTMENT OF FISH AND WILDLIFE

PREPARED FOR:

U.S. DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION,
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PROJECT NUMBER 95-01

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Executive Summary

In 1997 the Kalispel Natural Resource Department (KNRD) in conjunction with the Washington Department of Fish and Wildlife (WDFW) continued the implementation of a habitat and population enhancement project for bull trout (Salvelinus confluentus), westslope cutthroat (Oncorhynchus clarki lewisi) and largemouth bass *(Micropterus* salmoides). Habitat enhancement measures, as outlined in the recommendations from the 1996 annual report, were conducted during field season 1997. Fencing and planting of riparian areas and instream structures were implemented. As a precursor to these enhancement efforts, pre-assessments were conducted to determine the affects of the enhancement. Habitat quality, stream morphology and fish populations were pre-assessed. This *season* also began the first year of post-assessment monitoring and evaluation of measures implemented during 1996. The largemouth bass hatchery construction was completed in October and the first bass were introduced to the facility that same month. The first round of production is scheduled for 1998.

Acknowledgments

We would like to thank Glen Nenema (Chairman, Kalispel Tribal Council), the Kalispel Tribal Council and members of the 'Tribe for providing the support and the opportunity to conduct this research. We would also like to recognize the Washington Department of Fish and Wildlife for their support in this joint project. We would like to acknowledge the specific contributors to the authorship of this document Christopher L. Donley (WDFW) and Neil W. Lockwood Jr. (KNRD). The U.S. Department of Energy, Bonneville Power Administration, provided financial support for this project, contract number 95-Bl-37227. The Kalispel Natural Resource Department provided field support and equipment.

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Introduction

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The Kalispel Resident Fish Project (a joint effort between the Kalispel Natural Resource Department and the Washington Department of Fish and Wildlife) began in 1995 with the selection of the study tributaries and the assessment of fish populations and habitat conditions in those tributaries. Based on the assessments taken during that initial field season, a process was developed to filter out the reaches of these tributaries that contained the most numerous limiting factors to fish habitat quality and quantity. A set of recommended enhancement measures were subsequently developed for each of these reaches that are intended to address the specific habitat shortcomings. This list of recommendations was implemented during field season 1996 and became the core for additional recommendations for 1997 and 1998. Field season 1997 began the second year of implementation for recommended enhancement measures for the seven designated study tributaries. This season also began the first year of a three-year post assessment for all implemented recommendations. An additional 49 sites were selected to undergo an intense pre-assessment prior to implementation of instream structures. Pre-assessments and post-assessments were conducted and scheduled instream structures were constructed. In addition to the instream structures, a third fencing enclosure was constructed.

Largemouth bass habitat enhancement

The Upper Columbia United Tribes Fisheries Center conducted a three-year baseline study to assess the fishery improvement opportunities on the Pend Oreille River (Ashe 1992). Based on earlier estimates of aquatic macrophyte community composition (Falter et al. 1991) and limited ovetwinter survival of 0+ largemouth bass (Bennett *et al.* 1991) they suggested that the winter reduction in macrophyte communities created higher predation rates on 0+ bass. This led to their recommendation for the construction and placement of artificial cover structures to increase the amount of winter cover available in the reservoir. This season the Kalispel Resident Fish Project began the implementation of an artificial habitat study to determine what types of artificial structures and placement can provide the missing winter cover component. Pre-assessments were conducted on selected treatment and control sloughs. Upon completion of the pre-assessments, 100 Berkley artificial structures and 100 Pradco artificial structures were constructed and placed in study sloughs.

Description of Study Area

The Pend Oreille River begins at the outlet of Pend Oreille Lake, Idaho, and flows in a westerly direction to approximately Dalkena, Washington. From Dalkena the river turns and flows north into British Columbia, where it flows into the Columbia River. The approximate drainage area at the international border is 65,300 km^2 (Barber et al. 1990). The normal high flow month is June with a mean discharge of 61,858 cfs, the normal low flow month is August with a mean discharge of 11,897 cfs (Barber et al. 1990). The Box Canyon Reservoir has 47 tributaries and covers 90 river kilometers of the Pend Oreille River, from Albeni Falls Dam at the southern border to Box Canyon Dam at the northern border.

The bass habitat enhancement study will be located in zero flow areas of the reservoir. The favored sites would be off the mouths and inside sloughs. Four sloughs will be used for the study; Campbell slough adjacent to the Pend Oreille Wetlands Wildlife Mitigation Project, located on the east side of the Box Canyon Reservoir, at river km 99. No Name slough located directly across the reservoir from Campbell slough, on the west side of the reservoir, at river kilometer 99, Cee Cee Ah and Old Dike sloughs contained within the Kalispel Reservation and located on the east side of the reservoir at river km 109 and river km 107 respectively.

Methods

Bull trout and cutthroat trout habitat assessment andpopulation abundance

The stream habitat survey methodology contained four facets: transect surveys, reach overviews, interreach comparisons and fish surveys. The compilation of transect surveys and reach overviews were used to define the most degraded reaches through interreach comparisons. Snorkel surveys and electroshocking were used to determine fish population densities and age class distribution for all salmonid populations within each stream and *were* combined with the interreach comparisons to draw conclusions on the effects of degraded habitat quality and non-native salmonids on native salmonid species. Conclusions were used to aid in more informed restoration recommendations. Stream and fish population survey methodology used within the Box Canyon Reach is similar to that developed by Espinosa (1988) and further revised by Huntington and Murphy (1995) (KNRD internal doc. l-95).

Habitat surveys were broken into two components 1) transect surveys and 2) reach overview surveys. Transect surveys are the division of the stream into 30m segments. Primary pools, spawning habitat and acting woody debris counts were collected for the entire length of each 3Om segment, The remainder of the habitat quality parameters in Table I were collected at the end of each 30m segment (the actual transect site). This method allows for a number value to be assigned to each habitat quality parameter. Reaches were defined by stretches of stream with common gradient, substrate and vegetation. Breaks between two homogeneous areas defined a new reach. Reach overview surveys are the visual observation and description of variables occurring within each reach (Table 2). Each reach was permanently marked and flagged using aluminum tags and flagging as a reference point for long-term monitoring.

Following the compilation of transect data, an interreach comparison was conducted using the mean values for each reach. This was the fundamental unit of comparison to determine specific reaches for enhancement projects. Threshold values were established for embeddedness, bank stability, bank cover, instream cover, pool-riffle ratio, spawning gravel and primary pools (Table 3). All threshold values were obtained from Hunter (1991) and/or MacDonald *et* al. (1991). The mean data for each reach was analyzed by using these threshold criteria. Each habitat value that did not fall within the threshold was counted as habitat that was unsatisfactory for quality or quantity. The reaches with the most numerous unsatisfactory habitat values were identified as enhancement sites for that particular stream.

The data from the specific reaches identified in the inteneach comparison were evaluated in a flowchart to provide a list of possible options for the types of structures or measures to be used in enhancement (Figure 1). Each structure is designed to perform specific functions and requires specific habitat placement (Table 4). Specific structure selection was made by reviewing the list of options for enhancement and choosing the structure that addresses the limiting factors for each particular reach of enhancement. Reach accessibility was also considered when choosing between structures with similar function but varying levels of effort in their construction. Specific placement was determined by the transects within each reach that were in the habitat type each 'structure was designed for.

Fish density estimates were collected using standard snorkel survey techniques (Espinosa 1988). Sampling was conducted during the period from July 15 through September 15. Population density was addressed by number, size (age class) and species of fish per $100m^2$ (Table 5). The standard size/age classes for salmonid species were determined according to Espinosa (1988). Lengths of stations were 30 meters and selected so that beginning and ending points for stations never bisected pool habitat. Fish stations were permanently marked and flagged using aluminum tags and flagging.

Table 1. Transect Variables and Method of Collection.

Variable	Method of collection
Habitat Type	Visually determine habitat types (i.e., pool, riffle, glide, pocketwater, run, alcove).
Dominant Substrate Size	Visually determine largest percentage of substrate for that habitat type (i.e., silt, sand, gravel, cobble, boulder, bedrock).
Habitat Function	Visually determine habitat functions (i.e., winter, summer, spawning or unusable).
Spawning Gravel Amount and Quality	Measure potential square meters of spawning gravels within each transect and quality (i.e. gravel size, location and current velocity Kalispel internal doc.l-95) Good = All criteria met. Fair = 2 criteria met. Poor = I criteria met.
Stream Depths	Measure depth at 1/4 1/2, 3/4 across channel to the nearest cm.
Habitat Widths	Measure each specific habitat type in a transect to the nearest 0. I m.
Primary Pools	Number of pools with length or width greater than the avg. width of stream channel within each transect.
Pool Quality	Rating based upon collection of length, width, depth, and cover.
Pool Creator	Identify item creating the pool (e.g., large woody debris, boulders, beaver, enhancement, other).
Cobble Embeddedness	Visual estimate of the percentage fine or coarse sediment surrounding substrate / Actual measurement was recorded with an embed meter approximately every 20 transects. Regression of the estimated numbers with the actual measurements calculated a correction factor for all estimated values.
Bank Stability	Visual estimate of the percentage of unstable bank per transect for possible sediment source.
lnstream Cover Rating	Percent of the stream surface covered by large woody debris, aquatic vegetation, bank vegetation in or near the surface of the water / Amount of cover provided by undercuts, root wads, boulders or turbulence.
Dominant/Subdominant Riparian Vegetation	Visual estimate of dominant vegetation and of subdominant vegetation species.
Stream Channel Gradient	Using a clinometer measure percent slope.
Acting Woody Debris	Number of woody debris with a diameter >IOcm and a length > I m in the stream.
Potential Debris Recruitment	Number of trees within the transect that could potentially fall into the stream > IO cm and a length > 1m.
Residual Pool Depth	The average pool depth by averaging the deepest portion of the pool and the pool tailout. Measure to the nearest cm.

Table 2. Reach Variables and Method of Collection.

Variables	Method of Collection
Air and Water Temperature	Thermometer reading in centigrade.
Channel Type	A general classification of channel type based on channel morphology (see Rosgen 1994).
Average Embeddedness	Estimate of the average embeddedness for the entire reach Actual measurement was recorded with an embed meter approximately every 20 transects, Regression of the estimated numbers with the actual measurements calculated a correction factor for all estimated values.
Dominant Habitat Type	Dominant habitat type for the reach (i.e., pool, riffle, glide, pocketwater, run, alcove).
Disturbance	Estimation of the effects of land use practices (i.e. logging, roads, cattle, mining).
Aquatic Vegetation	Estimation of the occurrence of aquatic vegetation for the reach (i.e., abundant, fairly common, scarce, none).
Shading	Visual estimation of the amount of stream shaded by canopy along the stream reach
Habitat Quality	Estimation of the habitat quality for the entire reach (i.e., good, fair, poor).
Other	Any notable attribute not required for recording that can be recorded for reference to impact, or in interest to habitat quality.

Table 3. Interreach comparison threshold values (after Hunter 1991; MacDonald 1991).

Limiting Factors	Threshold Value
Embeddedness	Any value > .30 or< .70
Bank Stability	Any value < 15%
Bank Cover	Any value < 2.5
Instream Cover	Any value < 2.0
Pool - Riffle Ratio	Any value <5:1 or >1.5:1
Spawning Gravel	Three lowest cumulative values
Primary Pools	Three lowest values

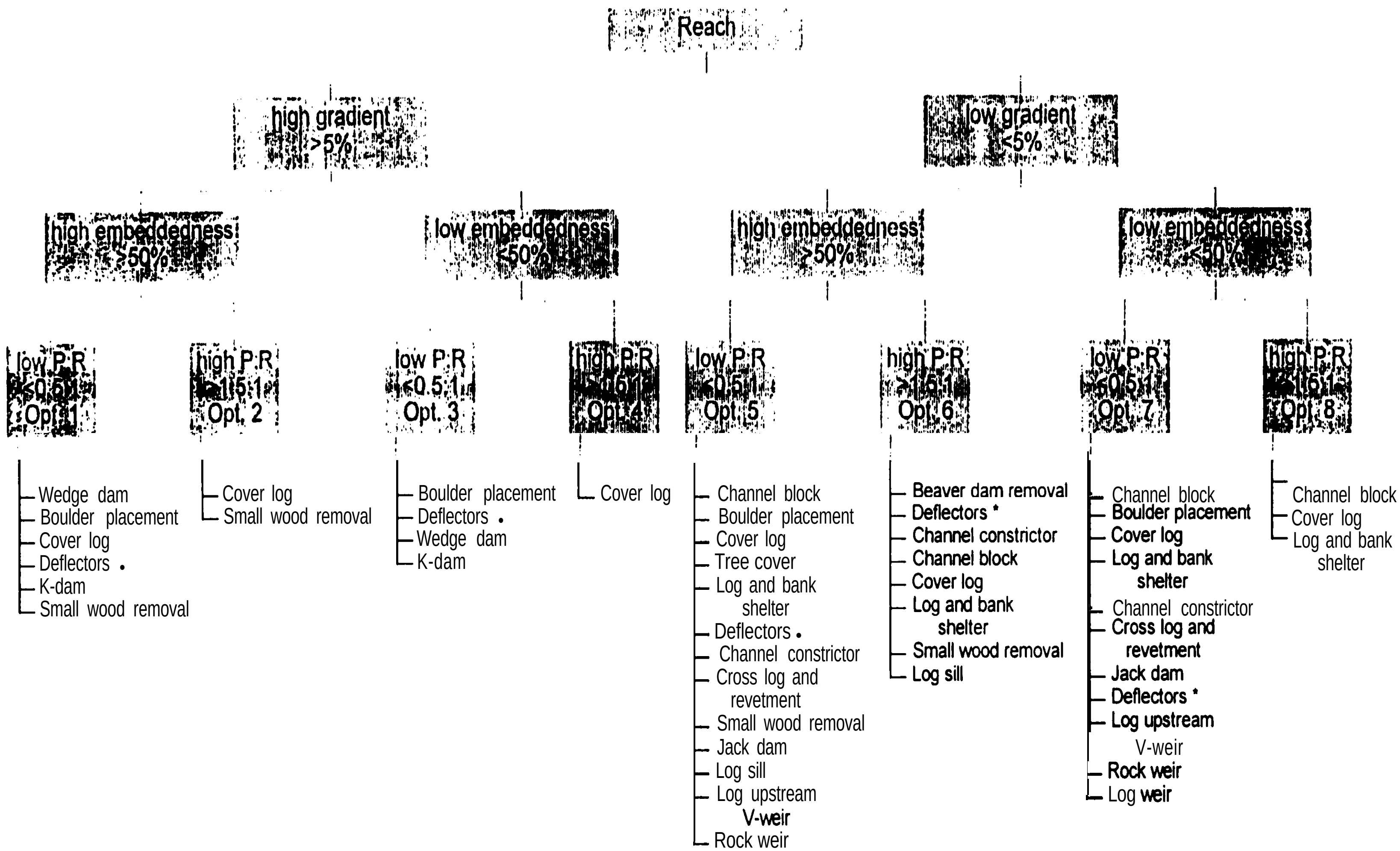

Figure 1. Flowchart for identified reaches of enhancement and the possible structures available for enhancement. Values derived after Harrelson *et al*. 1994, Macdonald 1991 and Hunter 1991.

Table 4. Instreams structures and the descriptions for placement requirements, function and impacts.

Structure	Habitat	Stream Requirements	Purpose	Impacts
Wedge dam	Riffles Runs	Well defined stream banks. Stream < 30 ft. wide. Gradient >S%. Substrate consisting of: rubble, cobble and gravel Ideal locations are at a break in gradient with a steeper section immediately upstream.	Creates a fair to excellent scour pool. Creates spawning gravel at tail-out of pool	+/ Creates calmer water above the structure. + Creates a scour pool below the structure. +/- May act as a trap for sediment.
Boulder placement	Riffles Runs Glides Open Pools	Greatest benefits in currents exceeding 2 feet per second. Suitable for any size stream.	Provides overhead cover and resting areas. Creates natural appearance.	+ Creates pocketwater behind boulder. + Added depth is also created by the scouring resulting from reduced channel capacity and increased current velocity.
Cover log	Open Pools Runs	Works best in meanders or in conjunction with deflectors. Requires adequate water depth (at least 8" deep.) Suitable for any size stream.	Provides optimum cover.	+ Creates overhead cover. + Directs current away from meander. - May cause unwanted bank cutting.
Single-Wing Deflector	Riffles Glides Runs	When possible, divert water into a relatively stable section of stream bank. Suitable for **a** variety of sites. Most suitable in wide shallow riffles.	Constricts and diverts water flow so that pools are formed by scouring. Creates spawning gravel.	+ Constricts and diverts water flow. +/- May cause deposition of sediment just below structure towards bank. + Directs meander - May cause unwanted bank cutting.

Table 4. continued

Structure	Habitat	Stream Requirements	Purpose	Impacts
Double-Wing Deflector	Riffles Runs Glides	Especially suitable for shallow sections of stream where the gradient is too steep for effective deflector and cover log.	Creates mid-channel pools through scouring. Creates spawning gravel at tail-out of pool.	+ Narrows channel. + Scours a pool below structure. +/- May cause deposition of sediment just below structure towards bank. - May cause unwanted bank cutting.
Channel Constrictor	Riffles Runs Glides	Provides best results when placed in long, straight, low-gradient stretches of stream.	Provides overhead cover. Narrows channel. Scour and deepen stream bed.	+ Scours the streambed. + Increases velocity. + Helps transport sediment. - May concentrate sediment below structure. +/- Incises the channel.
Log Deflector	Riffles Glides Runs	When possible, divert water into a relatively stable section of stream bank. Suitable for a variety of sites. Most suitable in wide shallow riffles.	Constricts and diverts water flow so that pools are formed by scouring. Creates spawning gravel	+ Constricts and diverts water flow. +/- May cause deposition of sediment just below structure towards bank. + Directs meander.
Log Paired Deflector	Riffles Runs Glides	Especially suitable for shallow sections of stream where the gradient is too steep for effective deflector and cover log.	Creates mid-channel pools through scouring. Creates spawning gravel at tail-out of pool.	+ Narrows channel + Scours a pool below structure. +/- May cause deposition of sediment just below structure towards bank.

Table 4. continued

Structure	Habitat	Stream Requirements	Purpose	Impacts
Rock Deflector	Riffles Runs Glides	When possible, divert water into a relatively stable section of stream bank. Suitable for a variety of sites. Most suitable in wide shallow riffles.	Directs flow from cut bank. Directs meander. Scours pool.	+ Constricts and diverts water flow. +/- May cause deposition of sediment just below structure towards bank. + Directs meander.
Boulder Paired Deflector	Riffle Runs Glides	Especially suitable for shallow sections of stream where the gradient is too steep for effective deflector and cover log.	Creates mid-channel pools through scouring. Creates spawning gravel at tail-out of pool.	+ Narrows channel. + Scours a pool below structure. +/- May cause deposition of sediment just below structure towards bank.
K - Dam	Riffles Runs	Well defined stream banks. Stream < I5 ft. wide. Gradient >S%. Substrate consisting of: rubble, cobble and gravel. Ideal locations are at a break in gradient with a steeper section immediately upstream.	Creates a fair to excellent scour pool. Creates spawning gravel at tail-out of pool.	+/- Creates calmer water above the structure. + Creates a scour pool below the structure. +/- May act as a trap for sediment. - Prone to undercutting of structure.
Small Wood Removal	Riffles Glides Runs	Small wood must be acting as a silt trap or inhibiting fish migration in order to be removed. Typically used to increase velocity and transport sediment.	Typically used to increase velocity and transport sediment. Helps expose substrate.	+ Increases velocity. + Transports sediment. + Exposes substrate. + Narrows channel.

Table 4. continued

Structure	Habitat	Stream Requirements	Purpose	Impacts
Channel Block	Braided Channel	Braided channel that is virtually unusable.	Consolidates flow . into a single, deeper channel.	+ Concentrates flow into a single deeper channel. + May increase velocity. - May concentrate sediment deposition downstream.
Tree Cover	Riffles Runs Glides	Suitable for a variety of sites. Greatest benefits probably occur in wide shallow streams with sand or gravel substrate.	Provides excellent overhead cover. Increases stream velocity. Transports sediment.	+ Constricts wide shallow channels. + Increases stream velocity. + Transports sediment.
Log & Bank Shelter	Open Pools	Suitable for use in low gradient. Stream bends or meanders. Can be used with a deflector.	Provides overhead cover. Provides some streambank protection.	+ Creates overhead cover. + Directs current away from meander.
Cross Log & Revetment	Riffles Runs	Structure works best in low gradient sections of the stream. Works even better at the beginning of wide, shallow bends with marginal pools or cover.	Creates scour pool. Creates overhead cover. Protects the bank.	+ Creates a scour pool. + Protects bank.
Jack Dam	Riffles Runs	High banks. Moderate to steep gradient.	Produces deep scour pools.	+/- Creates calmer water above the structure. + Creates scour pool.
Log Sill	Riffles Runs	Well defined stream banks. Stream < 15 A. wide. Gradient <5%.	Creates scour pool. May create spawning gravel.	+/- Creates calmer water above the structure. + Creates a scour pool below the structure. +/- May act as a trap for sediment.

Table 4. continued

Structure	Habitat	Stream Requirements	Purpose	Impacts
Log Upstream V-Weir	Riffles Runs	Well defined stream banks. Stream < IS ft. wide. Gradient <5%. Works well in sand and gravel substrate.	Creates deep plunge pool. Creates spawning gravel at tail-out of pool.	+/- Creates calmer water above the structure. + Creates a scour pool below the structure. +/- May act as a trap for sediment.
Rock Weir	Riffles Runs	Well defined stream banks. Stream < 15 ft. wide. Gradient <5%	Creates scour pool.	+/- Creates calmer water above the structure. + Creates a scour pool below the structure. +/- May act as a trap for sediment.
Log Weir	Riffles Runs	Well defined stream banks. Stream <I5 ft. wide. Gradient <5%	Creates scour pool.	+/- Creates calmer water above the structure. + Creates a scour pool below the structure. +/- May act as a trap for sediment.
Beaver dam removal	Long Pools	A beaver dam in the in the lower 2/3 of the stream . A beaver dam that may inhibit fish passage.	Narrows channel. Exposes substrate.	- Releases a large volume of sediment downstream. +/- Incises the channel . + Decreases sediment upstream. + May expose substrate such as cobble, gravel and boulders.

Table 5. Fish species age/length class distributions (Espinosa 1988).

Species	Age	Length
Cutthroat Trout	o+	<65mm FL
Rainbow Trout	I+	65-110 FL
	2+	111-150 mm FL
	3+	151-200 mm FL
	4+	201-305 mm FL
	BIG	> 305 mm FL
Bull Trout	o+	<65 mm FL
Brook Trout	1+	65-115 mm FL
Brown Trout	2+	116-165 mm FL
	3+	166-210 mm FL
	4+	2 1 l-305 mm FL
	BIG	>305 mm FL
Mountain Whitefish	N/A	< 100 mm
	N/A	100 - 305 mm
	N/A	> 305 mm
Sculpin	Total Number	Record Species If Possible
Sucker	Total Number	Record Species If Possible

All sites selected as areas for enhancement were pre-assessed using an intense version of the standard transect methodology, prior to implementation. The only modification to the transect methodology was shortening the length between transects. Riparian project areas were assessed with 10m transects for each kilometer where fencing and planting occurred. Instream structures were assessed using Sin transects from 30m above the structure site to 30m below.

Fish sample stations for riparian restoration were calculated to be one 30 meter snorkel station per every 250 meters of stream (Figure 2.). A minimum sample size of three snorkel stations for each restoration area was conducted, unless the area was less than or equal to 90 meters long, in which case the entire area was snorkeled. Assuming the lowest known bull trout population density (0.075 bull trout/30 meters) in the state of Washington (Hillman and Platts 1993) we were 95% confident that if bull trout were in the stretch of the stream we would observe them at this rate of sampling. Bull trout were used to determine the sample size because they are the least abundant native salmonid species in the area.

Each station was benchmarked at the upper and lower boundary with labeled aluminum tags attached to rebar stakes. The same stations will be sampled in the spring, summer, and fall. Data from snorkel stations will be used to determine densities of all fish species present. Fish sampling for instream structures was conducted with a 60m station, 30m above and 30m below, to determine the fish numbers and species associated with the structure. To avoid confusion of benchmarks, fish stations are located at the actual structure.

The first year of post-assessment monitoring and evaluation was also conducted on enhancement measures implemented last season. All instream structures were assessed and will be monitored annually for a period of three years. Riparian planting and cattle exclusion fence sites are intended to provide longer term rehabilitation over an extended time schedule. The rate of post-assessment sampling for these sites will be every third year. The post-assessments are a replication of the pre-assessments in the exact same area.

$$n = \frac{-ln(1 - a)}{b}$$

Where: n = the number of sample 30 meter snorkel stations
-ln = negative natural log
a = level of confidence
b = lowest density (fish/30m of stream) of bull trout in the state of Washington

Figure 2. Calculation for number of sample stations

Largemouth bass habitat enhancement

Selection of the sloughs used in the bass habitat study was based on the two types of sloughs available within the reservoir. The sloughs are either backwater stream mouths or dead end river backwater. Four sloughs were selected: one stream fed treatment slough, one stream fed control slough, one backwater treatment slough and one backwater control slough.

Each slough was sampled prior to artificial habitat installation. Two 75 meter transects were established for each slough beginning at the mouth of the slough for 75m with a 75m buffer and then the second transect for 75m. The buffer was established to avoid data collection overlap. Each transect was then electrofished for a period of 300 seconds and all fish were collected. Bass were recorded as to their length and total number all other fish were recorded as total numbers by species.

Two types of artificial structures were used in the treatment sloughs. The Berkley structures are four foot cubes of plastic slats that provide cover in the interstitial spaces. The Pradco structures resemble palm trees and provide cover under the palms. The placement of each type was alternated between the two treatment sloughs (Berkley in the mouth transect in one slough and in the inland transect of the second slough).

Results

Bull trout and cutthroat trout habitat assessment andpopulation abundance

This year's habitat data shows the pre-assessment data against the first year of post assessment data for enhancement measures implemented in 1996 (Table 6 and 7). The **fish population** data represents **a pre and post-assessment for the same enhancement** sites (Figure 3 through 14). A second set of pre-assessment **habitat** data represents the data collected for enhancement measures implemented this field season (Table 8 and 9). All recommended enhancement measure sites for each **reach** are being implemented in succession to the previous year's enhancements. This will allow implementation and assessments to overlap and enable us to analyze three separate years of enhancements as one unit of enhancement for each reach.

Of the 27 instream structures constructed in 1996 four failed completely and three others partially failed. The habitat data for the first year of post assessments **showed 60%** of the enhancement sites had a decrease in the embed rates of the substrate. In addition, 60% of the enhancement sites showed an increase in pool to riffle ratios. The third habitat component focused on by the enhancement measures was an attempt to increase spawning gravels. At this early stage in the post-assessment monitoring and evaluation 40% of the enhancement sites showed an increase in spawning gravels, however; 50% of the sites have shown a decrease.

The fish data shows a net gain in fish usage of the enhancement sites in 76% of the sites. The most significant redistribution in species populations for the fish data came from Indian Creek Reach 4, where the number of cutthroat found in the post-assessment was 6 times that of the pre-assessment. This reach also contained the only **bull** trout found during this season's surveys.

Largemouth bass habitat enhancement

The pre-assessment for the sloughs to be used in the habitat study yielded only 6 largemouth bass (Table 10). As expected from previous river samples, the most populous species sampled were perch and pumpkinseed (Table 11). The bass populations comprised less than 3% of the total population within the study slough transects. Following the population samples, 100 artificial structures were placed in each treatment slough. The first post-assessment will take place as close to mid-to-late winter as conditions allow.

Table 6. Mean 5m pre-assessment habitat data paired with post-assessment by reach.

	CEE CEE AH Pre-Reach 4 1996		CEE CEE AH Post-Reach 4 1997		CEE CEE AH Pre-Reach 5 1996		CEE CEE AH Post-Reach 5 1997		CEE CEE AH Pre-Reach 6 1996		CEE CEE AH Post-Reach 6 1997		WHITEMAN Pre-Reach 5 1996		WHITEMAN Post-Reach 6 1997	
Habitat Variables	Mean	S.D.	Mean	S.D.	Mean	SD.	Mean	SD.	Mean	SD.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Embeddedness (%)	47.9	27.2	52.5	16.5	77	18	56.3	16.1	58.6	21.7	60.6	15.9	54.1	19.3	66.8	17.5
Bank Stability	86.1	7.7	71.6	4.3	77.9	6.5	74.3	5.7	72.2	11.5	75.8	4.45	80.5	6.9	79	6.6
Bank Cover	2.9	1.2	1.6	0.51	3.9	0.32	2.1	0.73	3.4	1	2.3	0.7	2.2	0.81	2.6	0.93
Instream Cover	4.3	0.76	2.2	0.88	4	0.2	2.4	0.75	3.5	0.8	2.4	0.73	2.5	1	2.4	0.98
Pool-Riffle Ratio	4:1		4:1		2:1		.2:1		.2:1		.4:1		.2:1		.4:1	
Acting Debris (#l1 OOm)	37.9		40		73.1		81.5		15.6		43.6		70.9		41	
Primary Pools (#/Km)	13.8		8		15.4		44.4		37		36.4		0		9.5	
Avg. Depth (cm)	18.8		23		16.2		43.1		18.7		23.9		19.9		20.3	
Avg. Stream Width (m)	3.1		3.2		3.1		6.4		2.5		2.9		3.9		4.1	
Spawnnlng Gravel (sq m)	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
Poor:	13.1	4	0	0	0	0	3	0	5.1	5.3	1.5	0	0	0	0	0
Fair:	12.7	4.1	0	0	0	0	0	0	2.6	1.1	0	0	0	0	0	0
Good:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Habitat Function	Occurrence		Occurrence		Occurrence		Occurrence		Occurrence		Occurrence		Occurrence		Occurrence	
Unusable:	2.1%		0.0%		0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
Summer:	90%		89.8%		97.3%		88.9%		94.2%		82.5%		93.1%		91.6%	
Winter:	6.5%		10.2%		2.7%		11.1%		5.8%		17.5%		6.9%		6.4%	
Spawning:	1.4%		0.0%		0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	

Table 6. Continued

Habitat Variables	WHITEMEAN Pre-Reach 6 1996 Mean	SD.	WHITEMAN Post-Reach 6 1997 Mean	SD.	MINERAL Pre-Reach 1 1998 Mean	S.D.	MINERAL Post-Reach 1 1997 Mean	SD.	MILL Pre-Reach 8 1996 Mean	S.D.	MILL Post-Reach 8 1997 Mean	SD.	INDIAN Pre-Reach 3 1996 Mean	S.D.	INDIAN Post-Reach 3 1997 Mean	S.D.
Embeddedness (%)	73.3	13.6	52.7	20.8	52.8	28.4	37.6	24.3	72.8	22.7	86.5	15.3	79.9	27.7	59.6	24
Bank Stability	85.7	12.2	74.3	8.16	75.5	16	83.9	8.67	45.8	11.7	60.3	8	86	14.7	89.8	2.8
Bank Cover	2	0.58	3	1.15	2.4	1.3	2.5	0.73	2.1	0.63	2.4	0.5	3.1	0.75	2	0.88
Instream Cover	2.2	0.68	2.6	0.66	3.9	0.93	3	0.9	2.4	0.72	2.4	0.75	4.2	0.46	2.4	0.58
Pool-Riffle Ratio	.3:1		.4:1		.5:1		.3:1		.2:1		.3:1		.2:1		.5:1	
Acting Debris (#/l 00m)	36.4		60.9		19.4		21.8		43.3		97		14.4		19.1	
Primary Pools (#/Km)	0		0		24.2		0		0		0		0		17.4	
Avg. Depth (cm)	23.4				18.4		18.9		40.2		28.8		25.7		42.7	
Avg. Stream Width (m)	3.8				2.6		3		5.9		6		4.2		4.8	

Spawnlng Gravel (sq m)	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
Poor:	2	2	0	0	10.1	14.3	0	0	2	2	9.5	0.6	12	12	3.5	3.5
Fair:	0	0	0	0	15.5	1	0	0	0	0	0	0	8	8	13.5	10.5
Good:	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	0

Habitat Function	Occurrence	Occurrence	Occurrence	Occurrence	Occurrence	Occurrence	Occurrence	Occurrence
Unusable:	0.0%	0	0.0%	0	0.0%	0.0%	9.7%	0.0%
Summer:	91.7%	70.3%	93.9%	97.2%	94.1%	86.1%	90.3%	46.7%
Winter:	8.3%	29.7%	3.3%	2.8%	5.9%	13.9%	0.0%	51.3%
Spawning:	0.0%	0	2.8%	0	0.0%	0	0.0%	0.0%

Table 6. Continued

	INDIAN		INDIAN	
	Pm-Reach 4		Post-Reach 4	
	1996		1997	
Habitat Variables	Mean	SD.	Mean	S.D.
Embeddedness (%)	5 2 . 56		1 5 . 97 . 1	
Bank Stability	79.4	14.4	81	7.9
Bank Cover	4	1.3	2	0.75
instream Cover	4.7	0.95	3	0.2
Pool-Riffle Ratio	0		.2:1	
Acting Debris (#/lOOm)	29.2		32.5	
Primary Pools (#/Km)	8.3		25	
Avg. Depth (cm)	24.2		28.7	
Avg. Stream Width (m)	3.3		4.3	

Spawnnlng Gravel (sq m)	Spring	Fall	Spring	Fall
Poor:	5	2	5	5
Fair:	3.5	3.5	8	0.5
Good:	0	1	0	0

Habltat Function	Occurrence	Occurrence
Unusable:	0.0%	0.0%
Summer:	100.0%	82.4%
Winter:	0.0%	17.6%
Spawning:	0.0%	0.0%

Table 7. Mean lOm pre-assessment data paired with post-assessment by reach:

	MILL		MILL	
	Pre-Reach 4		Post-Reach 4	
	1996		1997	
Habltat Variables	Mean	S.D.	Mean	S.D.
Embeddedness (%)	58.1	17.5	51.1	19.3
Bank Stabtlity	04.1	7.2	90.5	4.4
Bank Cover	2.9	1.1	1.6	0.63
Instream Cover	3.1	0.9	2.4	0.67
Pool-Riffle Ratio	.2:1		.2:1	
Acting Debris (#/100m)	61.8		49	
Primary Pools (#/Km)	20		22	
Avg. Depth (cm)	27.9		lg.8	
Avg. Stream Width (m)	4		3	

Spawnnlng Gravel (sq m)	Spring	Fall	Spring	Fall
Poor:	3.5	7	11.5	8
Falr:	0	3.5	4.6	4.5
Good:	0	0	0	0

Habitat Function	Occurrence	Occurrence
Unusable:	0.0%	0.0%
Summer:	57.5%	70.4%
Winter:	42.5%	21.6%
Spawning:	0.0%	0.0%

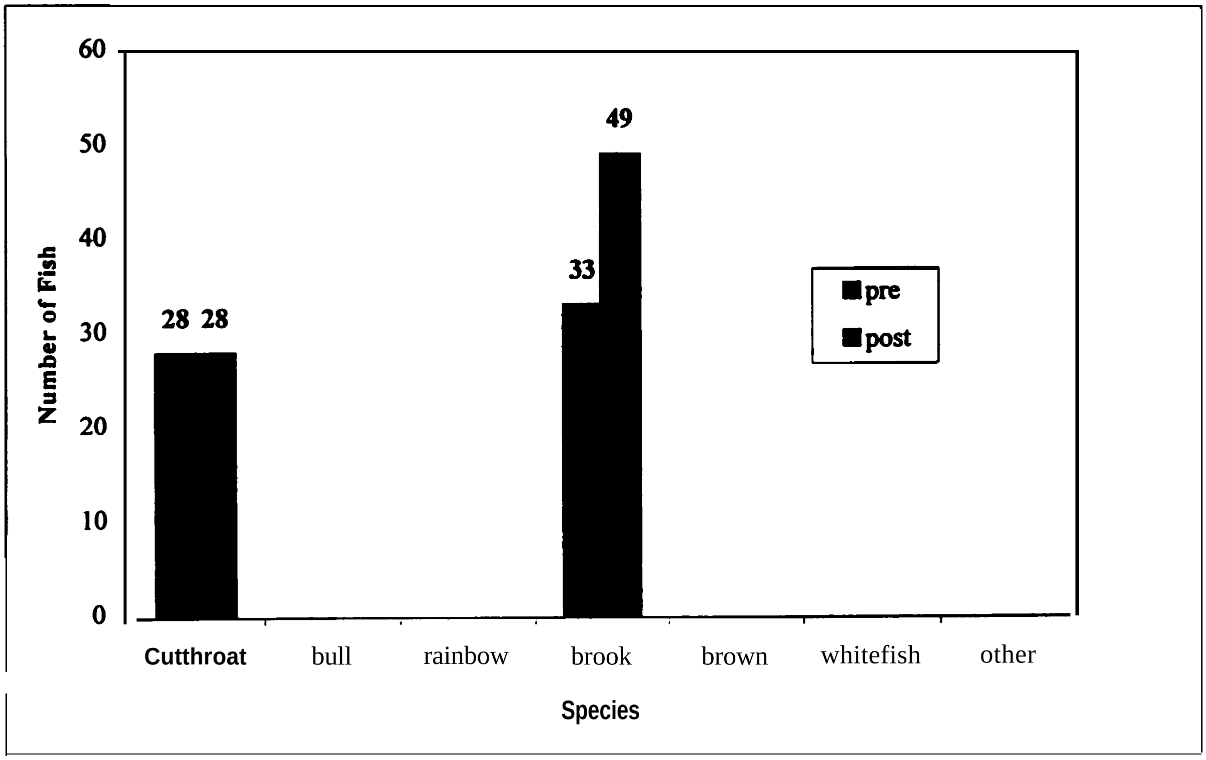

Figure 3. Pre and post Assessment Fish Data for Mill Creek Reach 4.

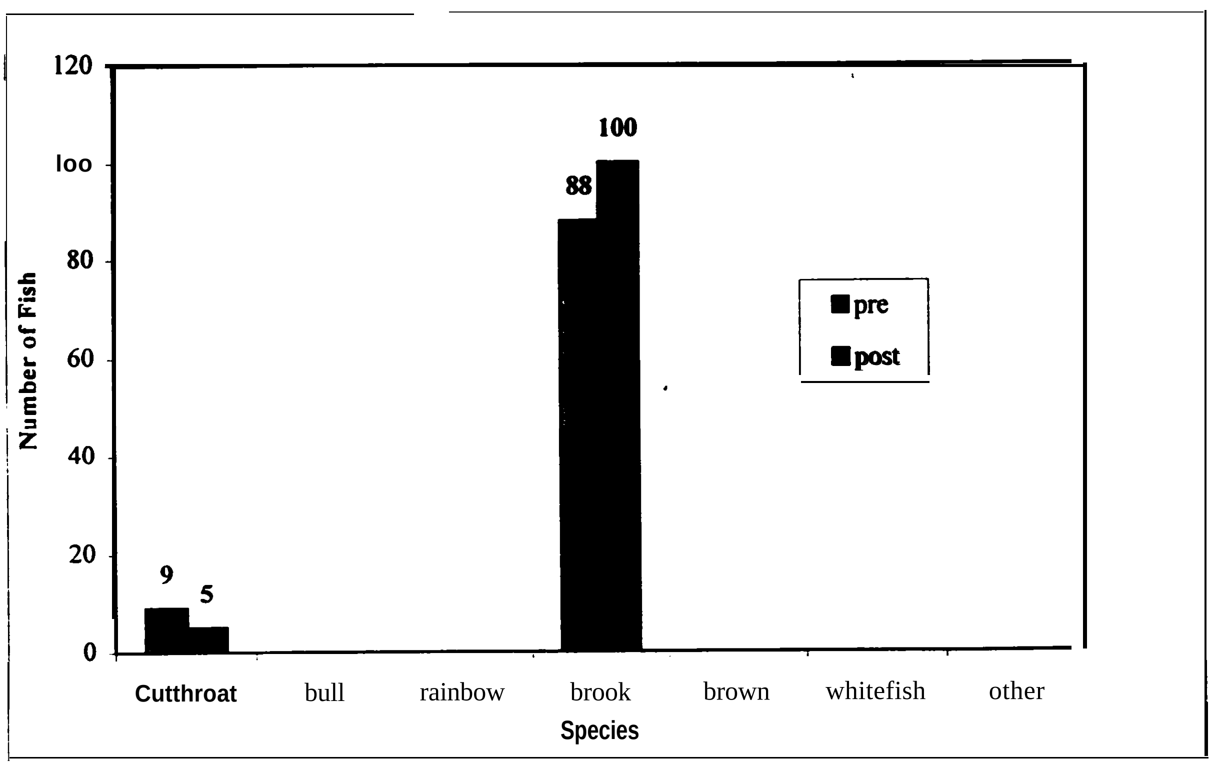

Figure 4. Pre and post Assessment Fish Data for Mill Creek Reach 8.

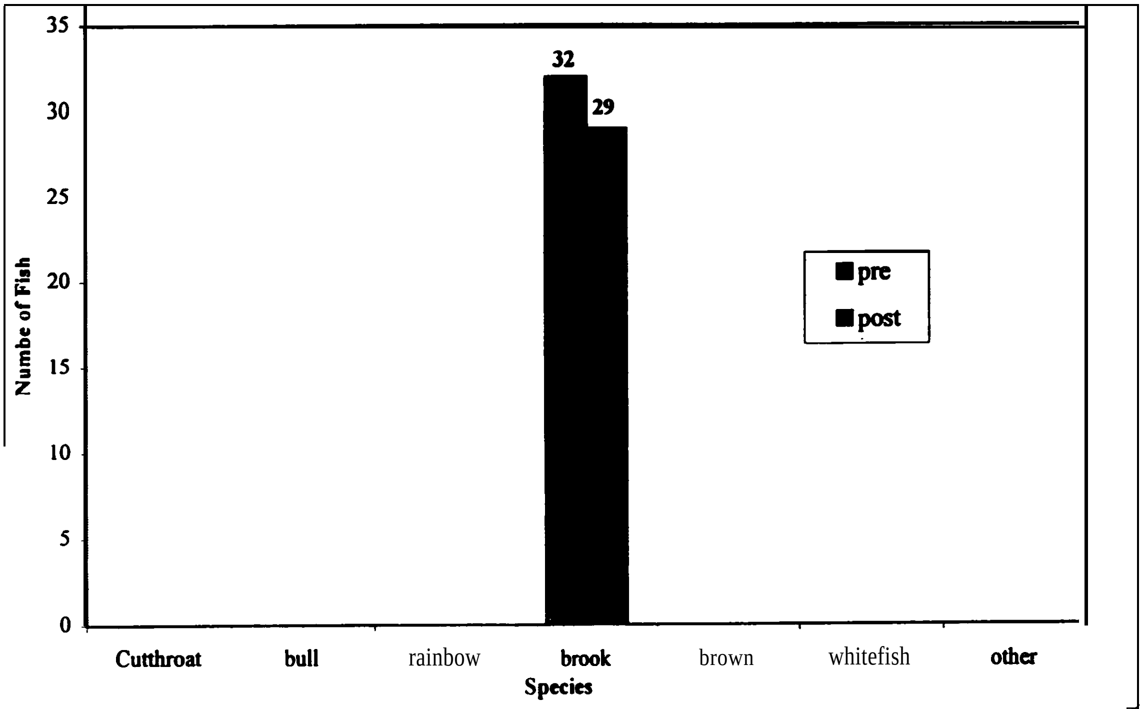

Figure 5. Pre and post Assessment Fish Data for Cee Cee Ah Creek Reach 4.

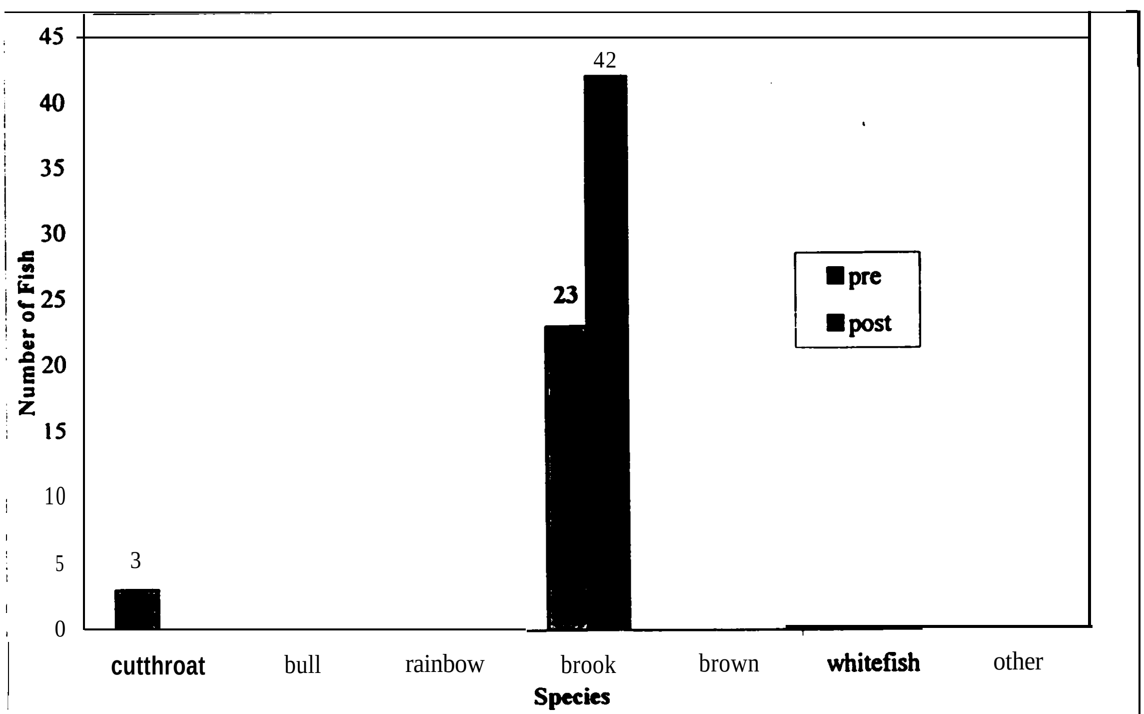

Figure 6. Pre and post Assessment Fish Data for Cee Cee Ah Creek Reach 5.

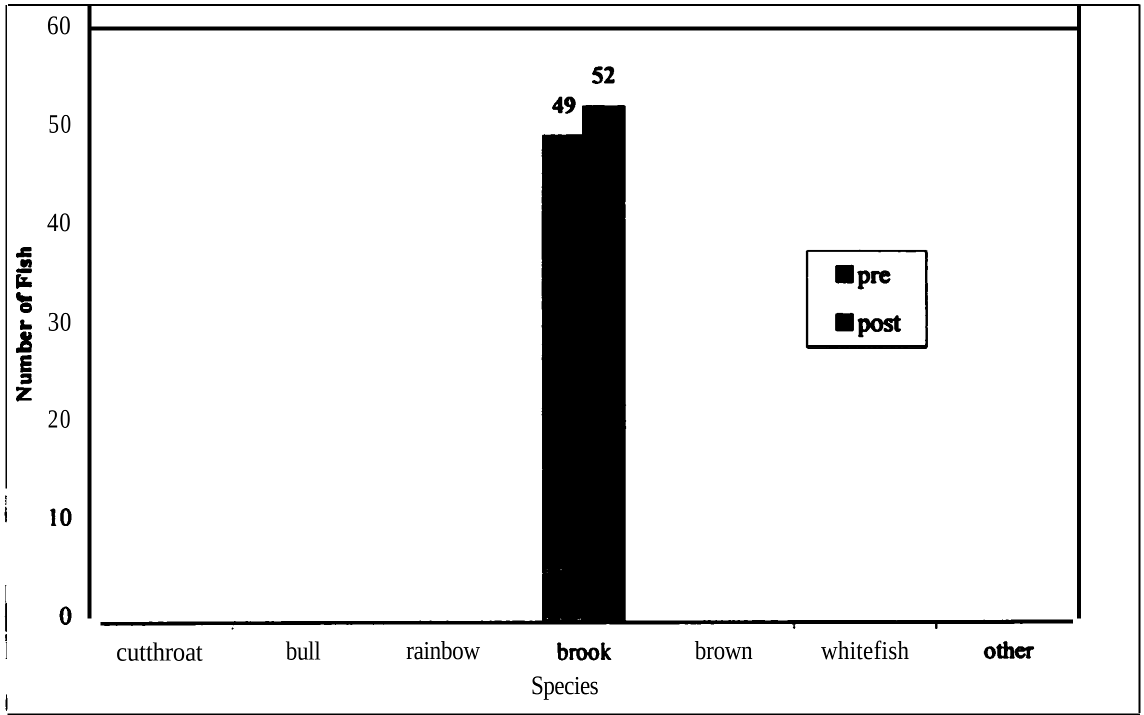

Figure 7. Pre and post Assessment Fish Data for Cee Cee Ah Creek Reach 6.

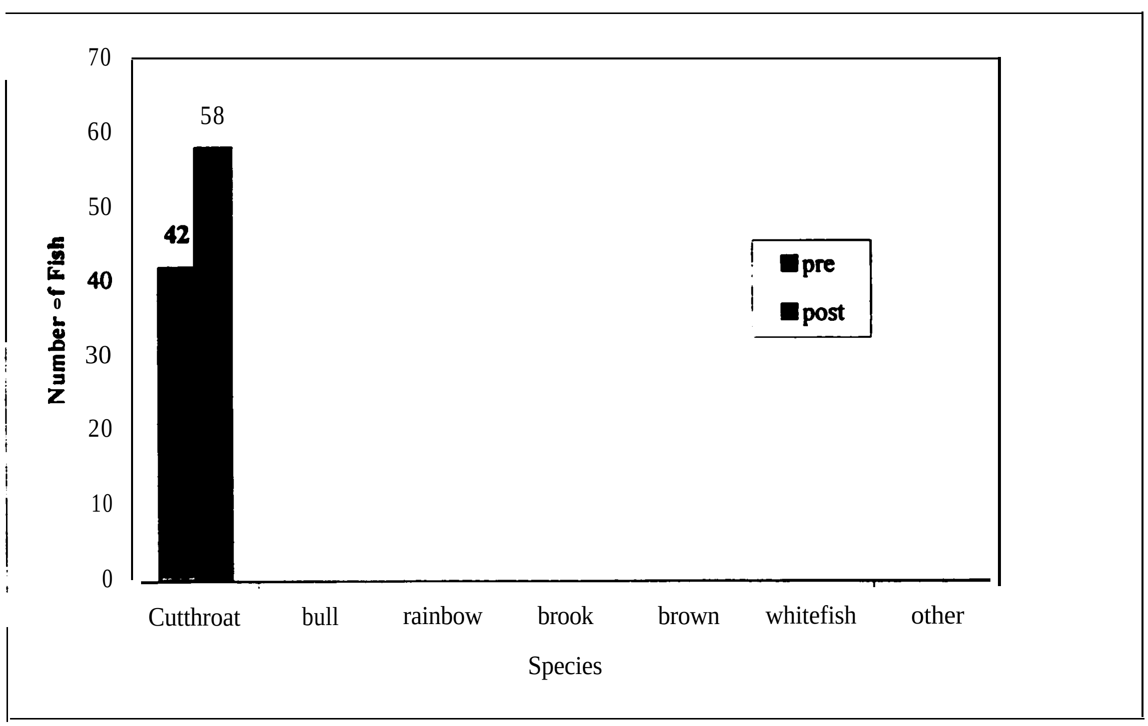

Figure 8. Pre and post Assessment Fish Data for Fourth of July Creek Reach 4.

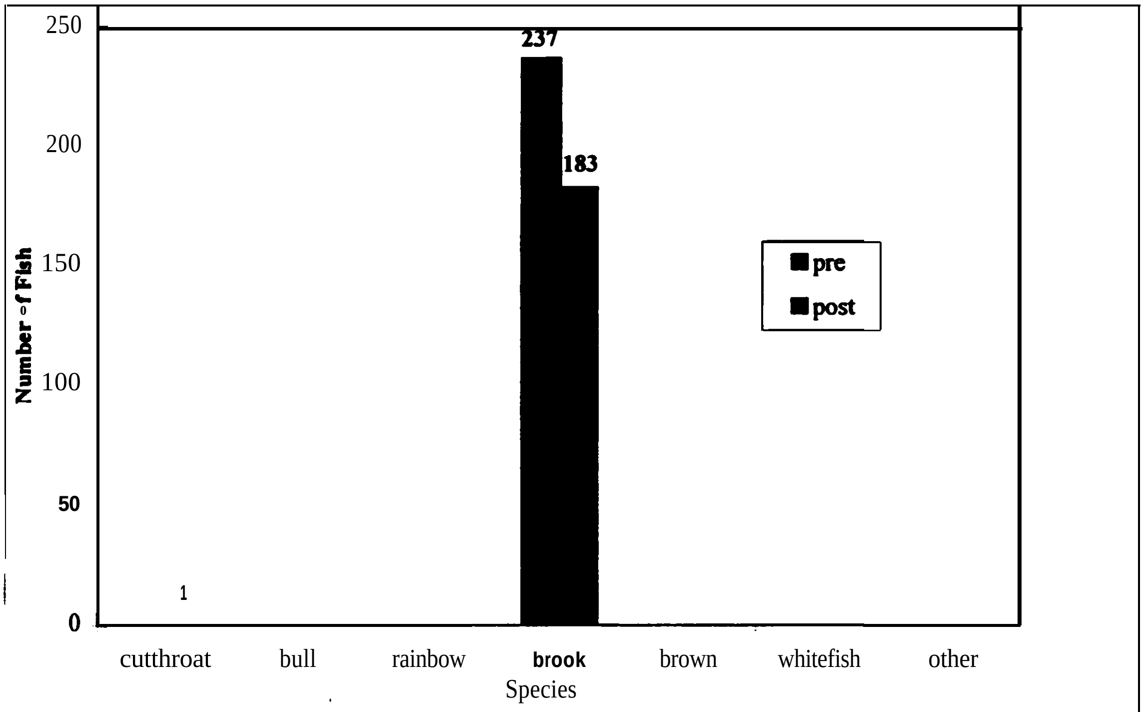

Figure 9. Pre and post Assessment Fish Data for Whtieman Creek Reach 4.

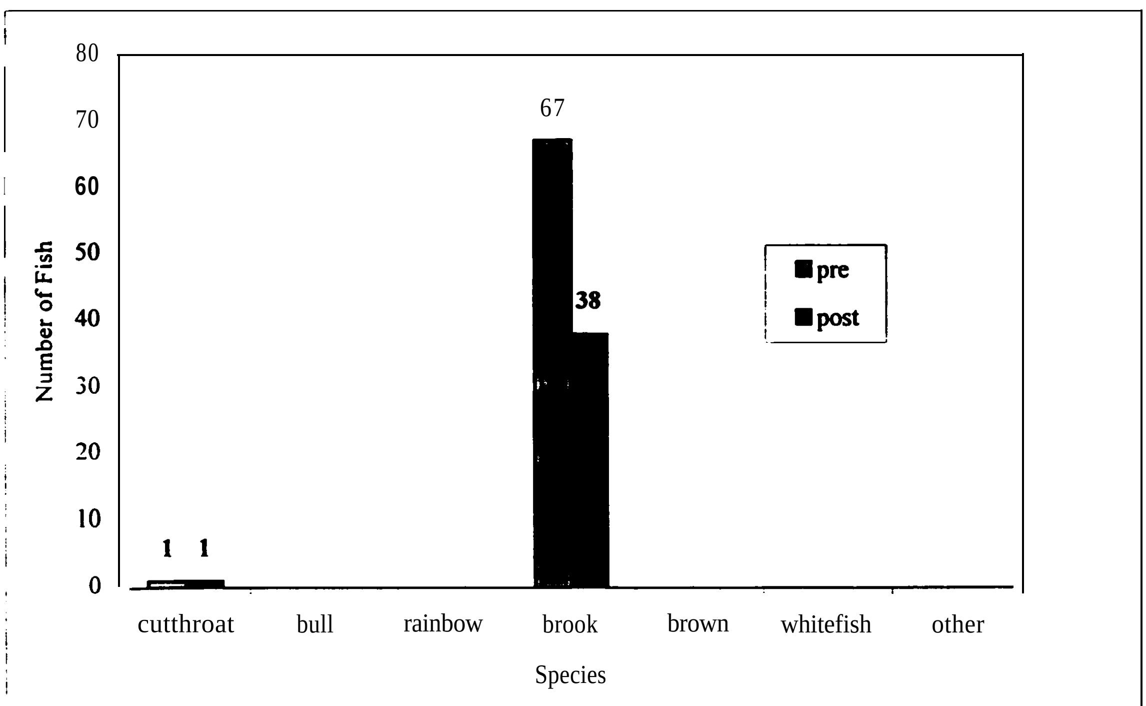

Figure 10. Pre and post Assessment Fish Data for Whiteman Creek Reach 5.

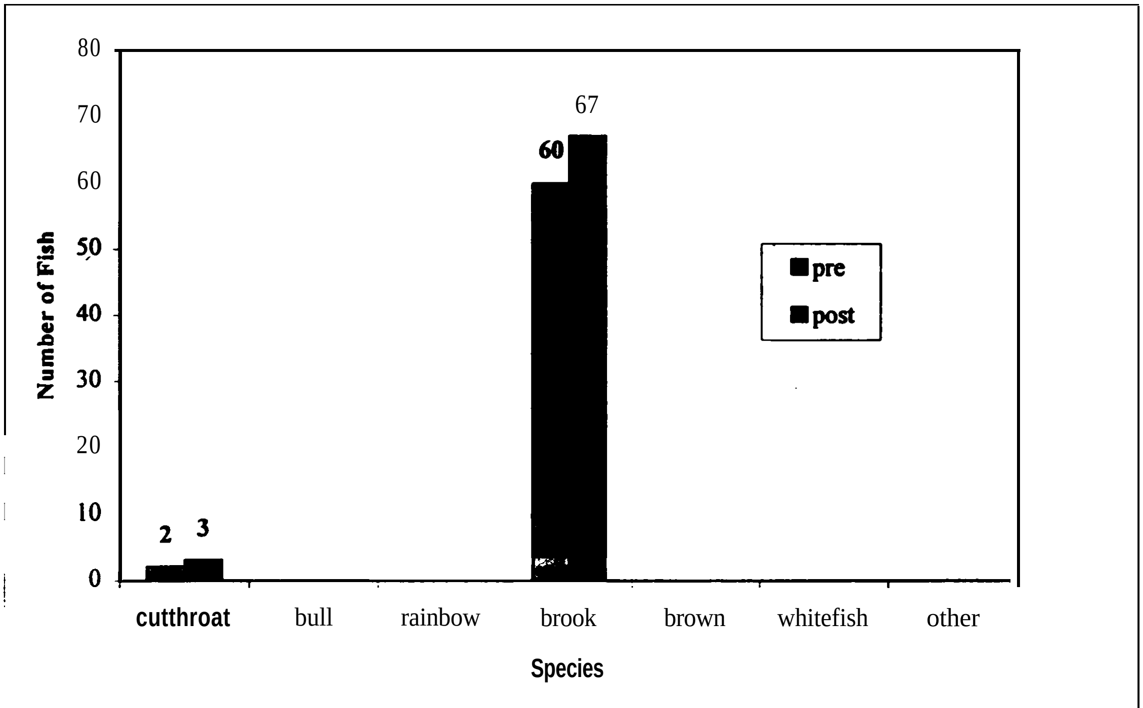

Figure 11. Pre and post Assessment Fish Data for Whiteman Creek Reach 6.

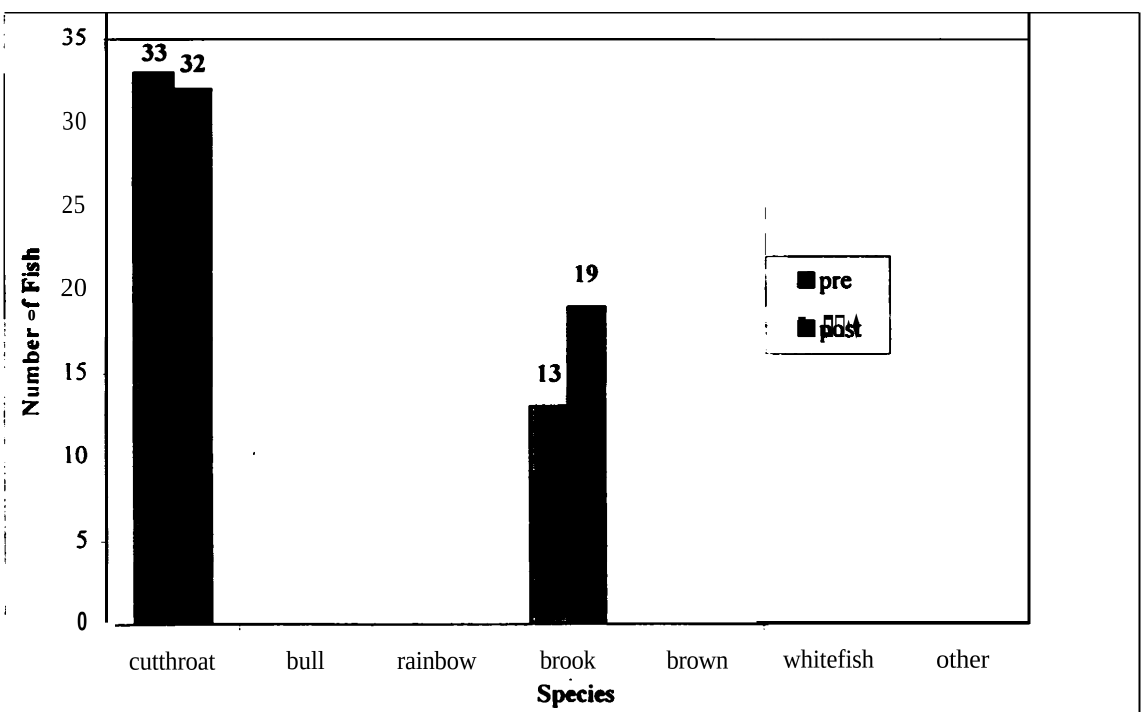

Figure 12. Pre and Post Assessment Fish Data for Mineral Creek Reach 1.

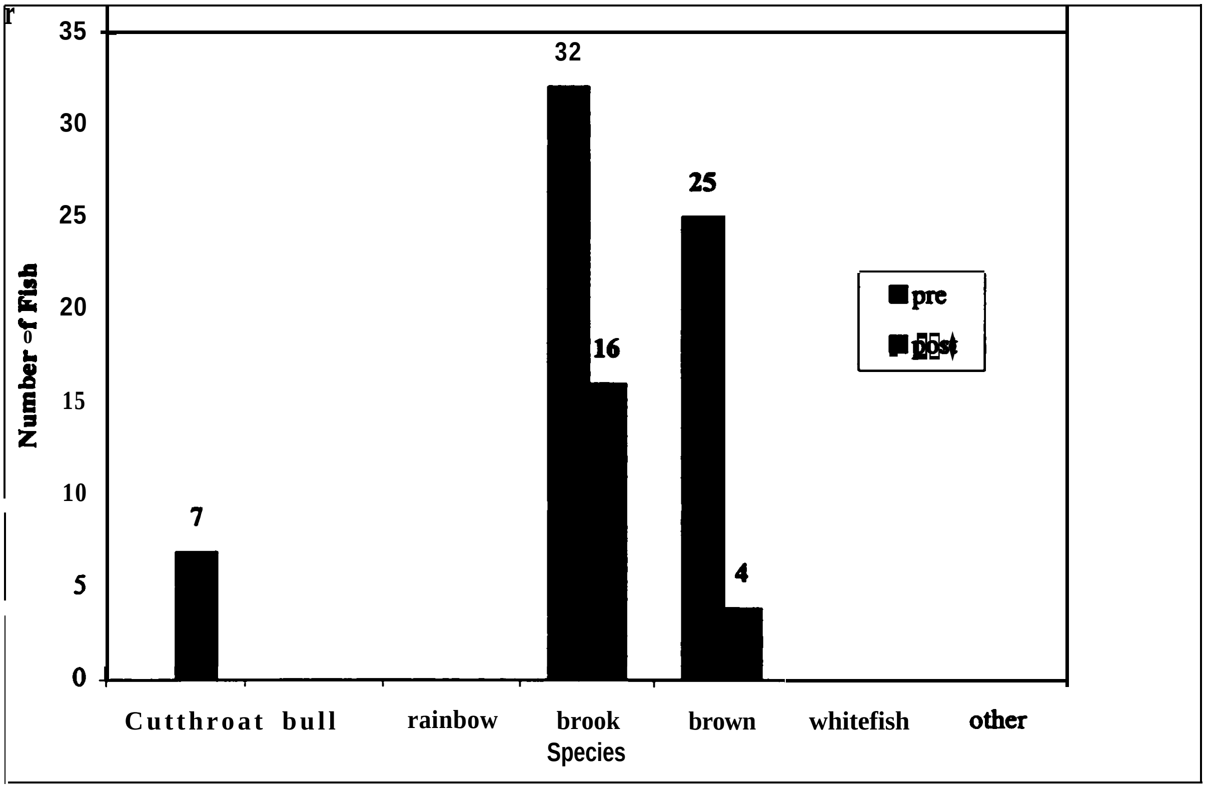

Figure 14. Pre and post Assessment Fish Data for Indian Creek Reach 3.

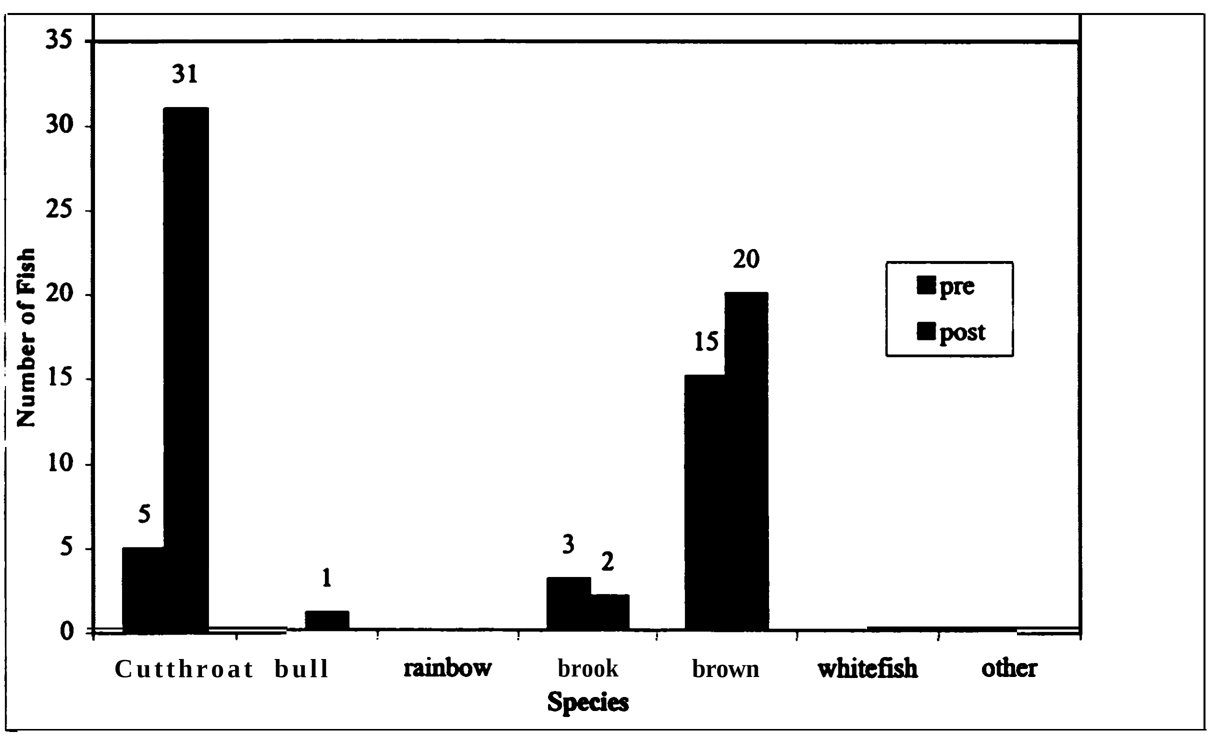

Figure 15. Pre and post Assessment Fish Data for Indian Creek Reach 4.

Table 8. Mean 5m pre-assessment data by reach.

	CEE CEE AH		CEE CEE AH		CEE CEE AH		MINERAL		4TH OF JULY		INDIAN		INDIAN		BROWN8	
	Pre-Reach 4		Pre-Reach 6		Pre-Reach 6		Pre-Reach 1		Pre-Reach 8		Pro-Reach 3		Pm-Reach 4		Pro-Reach 4	
	1997		1997		1997		1997		1997		1997		1997		1997	
Habltat Variables	Mean	SD.	Mean	SD.	Mean	SD.	Mean	SD.	Mean	S.D.	Mean	SD.	Mean	SD.	Mean	SD.
Embeddedness (%)	40.5	15.4	61.4	15.9	66.5	18.3	70.7	11.7	81.9	23.1	93.2	16.7	31	15	31.4	13.2
Bank Stability	80	5.8	79.4	4.8	73.2	4.2	73.2	8.3	88.1	7.9	86.3	5.2	81.8	4.7	71	5.3
Bank Cover	2	0.67	2.3	0.84	2.5	0.76	1.5	0.51	4	0	3.3	0.73	2	0.5	2	0.64
Instream Cover	2.8	1.3	2.9	0.56	2.3	0.91	1.9	0.75	4	0	3.5	0.51	3.5	0.71	2.6	0.75
Pool-Riffle Ratio	.7:1		.8:1		.6:1		.3:1		.l:l		1.51		.l:l		.l:l	
Acting Debris (#/l 00m)	42		31.1		58.6		24.7		34.3		12		29.4		43	
Primary Pools (#/Km)	2		11.1		28.6		23.5		0		0		11.8		0	
Avg. Depth (cm)	27.7		25.2		29.4		38.6		12.8		47.9		28.7		24.1	
Avg. Stream Width (m)	3.7		3.6		3.3		3.4		24		6.4		3.9		4.9	

Spawnlng Gravel (sq m)	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
Poor:	0.5	0	0	0	1	0	3.5	1	7	5.5	1.5	1.6	0.5	1.5	12	2
Fair:	0	0	0	0	0	0	0	0	2	2	0	0	1.5	0	20	8.5
Good:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0

Habltat Function	Occurrence	Occurrence	Occurrence	Occurrence	Occurrence	Occurrence	Occurrence	Occurrence
Unusable:	0.0%	0.00h	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Summer:	85.6%	76.6%	81.4%	70.2%	100.0%	98.8%	98.6%	94.2%
Winter:	14.4%	21.4%	, 18.6%	29.8%	0.0%	1.2%	1.2%	5.8%
Spawning:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table 8. Continued.

Habitat Variables	BROWNS Pre-Reach 9 1997 Mean	S.D.
Embeddedness (%)	48..5	27.5
Bank Stability	80	6.6
Bank Cover	2	0.72
Instretam Cover	2.8	0.57
Pool-Riffle Ratio	.7:1	
Acting Debris (#/l OOm)	42	
Primary Pools (#/Km)	0	
Avg. Depth (cm)	27.7	
Avg. Stream Width (m)	3.7	

Spawnnlng Gravel (sq m)	Spring	Fall
Poor:	0.5	0
Fair:	0	0
Good:	0	0

Habitat Function	Occurrence
Unusable:	0.0%
Summer:	85.6%
Winter:	14.4%
Spawning:	0.0%

Table 9. Mean lOm pre-assessment data by reach.

Habitat Variables	MILL Pre-Reach 8 1997 Mean	SD.
Embeddedness (%)	55.4	10.8
Bank Stability	88	7.9
Bank Cover	1.6	0.77
Instream Cover	2.8	0.88
Pool-Riffle Ratio	.2:1	
Acting Debris (#/1 oom)	63.5	
Primary Pools (#/Km)	25	
Avg. Depth (cm)	19.6	
Avg. Stream Width (m)	3.2	

Spawnnlng Gravel (sq m)	Spring	Fall
Poor:	0	0
Fair:	0	0
Good:	0	0

Habitat Function	Occurrence
Unusable:	0.0%
Summer:	78.2%
Winter:	21.8%
Spawning:	0.0%

LMB	Campbell Slough		No Name		Cee Cee Ah Slough		Old Dike Slough	
Size in mm	Transect 1	Transect 2	Transect 1	Transect 2	Transect 1	Transect 2	Transect 1	Transect 2
0 - 60	0	0	0	0	2	0	0	0
60-100	0	0	0	0	0	0	0	0
100 - 140	I	1	0	0	0	0	1	0
135 - 175	0	0	0	0	0	0	0	0
175 - 210	0	0	0	0	0	0	0	0
210 - 275	0	0	0	0	0	0	1	0
275 - 320	0	0	0	0	0	0	0	0
> 320	0	0	0	0	0	0	0	0

Table IO. Number of largemouth bass by size class sampled in bass habitat study.

		LM bass	perch	pumpkinseed	crappie	whitefish	trout	catfish	• uck8r	peamouth	tench	squawfish
Campbell Slough												
	Transect 1	1	8	0	1	1	0	1	1	1	0	0
	Transect 2	1	4	1	0	0	0	0	0	0	10	0
No Name Slough												
	Transect 1	0	3	1	0	0	0	0	0	0	2	0
	Transect 2	0	3	1	0	0	0	0	1	0	5	0
Old Dike Slough												
	Transect 1	2	36	52	9	0	0	0	0	0	22	1
	Transect 2	1	8	5	1	0	0	0	0	1	4	0
Cee Cee Ah Slough												
	Transect 1	2	5	5	0	0	0	2	0	0	0	1
	Transect 2	0	4	3	0	0	2	1	0	0	0	0
Total Number of Flsh		7	71	68	11	1	2	4	2	2	43	2

Table 11. Species and numbers of fish collected at each sample transect.

Discussion

Bull trout and cutthroat trout habitat assessment andpopulation abundance

The discussion of the results at this point will be very limited, as this is only the first year of a three year post-assessment monitoring and evaluation for all implemented measures. At the conclusion of the monitoring and evaluation phase for the pilot study tributaries, the compiled data will be thoroughly analyzed and a complete discussion addressed.

Of the seven structures that partially or completely failed, there were two types of failure associated with them. Four of these structures completely spanned the channel and the failure type was an undercutting that left the structure above the stream surface. The remaining three structures were boulder type weirs in areas where the available substrate was of an insufficient size to withstand the large run-off experienced in the spring of 1997. These structures were redistributed throughout the channel so as to provide no collective effect. The remainder of the 20 structures constructed in 1996 all remained in tact and at this early stage of their post-assessment appear to be providing the desired effects. Although the cattle exclusion fencing projects were designed to provide a more protracted benefit to the stream channels, the cosmetic effect to the riparian area was almost immediate. The ability of these disturbed areas to recover may have been greatly underestimated and the turn around time for the effects to become visible in the instream data may be sooner than originally anticipated.

The initial increases in habitat type redistribution and the decrease in some of the substrate embed rates are encouraging at this point in the enhancement efforts. To show any increase in habitat function in streams that were almost exclusively summer habitat is encouraging in and of itself. The apparent response of fish utilization to the added complexity of the habitat offers additional support to some level of artificial management within these degraded stream reaches. The mixed results in terms of increasing spawning gravels is not completely unexpected. The heavy embed rates in the preliminary assessments made it somewhat difficult to estimate substrate composition. Increasing the amount of spawning gravel in an area where little of that size material exists becomes problematic. Again, it is difficult to predict the final outcome of multiple years of effect on these enhancement measures and only supplemental monitoring will detail the final product.

Largemouth bass habitat enhancement

As the goal for this study is to provide over-winter cover to juvenile largemouth bass, the post-implementation assessments will be conducted as close to mid-winter as sampling constraints will allow. The first post-assessment will also be conducted before the first plant of largemouth bass produced at the Kalispel Hatchery. This will allow for at least one season's sample to represent the natural population usage of these sloughs as winter refuge.

Recommendations

Riparian area and instream restoration

Mill Creek

Reach 8

In order to increase the flow velocity in this reach, small woody debris will be removed. Increasing the velocity will decrease embeddedness for this reach and aid in scouring around structures previously implemented.

Cee Cee Ah Creek

Reach 4

One log sill will be constructed in four separate riffle transects to increase pool-riffle ratio and primary pools by scouring action in shallow sections of the stream. Increasing pools in this stream will increase winter habitat and instream cover. These structures may also act as sediment traps.

Reach 5

One cross log and revetment structure will be constructed in four separate riffle transects to create scour pools. The revetrnent logs will provide cover, protect banks, as well as, provide pockets of spawning gravel in the tailout area of the pools.

Reach 6

One log upstream v-weir will be constructed in four separate riffle transects. These structures will create deep plunge pools and spawning gravels in the pool tailout.

Browns Creek

Reach 4

One K-dam will be constructed in three separate riffle transects. These structures will provide scour pools below the structure and calmer water above.

Reach 9

One single-wing deflector will be constructed in three separate riffle transects. These structures will help to divert into relatively stable portions of the stream bank and direct meanders.

Fourth of July Creek

Reach 3

An additional 4,000 trees will be planted to vary the age class from last season's planting. 1000 black cottonwoods, 1000 western redcedar, 1000 spruce and 1000 red osier dogwoods will be planted.

Reach 8

One log weir will be constructed in three separate riffle transects. These structures will create scour pools and create calmer waters above the structure.

Whiteman Creek

Reach 4

One channel block will be constructed in three separate transects in a braided channel section. These structures will help to consolidate flow into a single deeper channel in an area almost unusable due to previous cattle induced bank erosion. Having fenced this reach this season, we will also try to provide some of the missing cover in this portion of the stream. One log and bank structure will be constructed in ten separate open pool transects to provide overhead cover and direct current away from meanders. Ten cover log structures will be constructed in pool/run transects, which also provide similar cover and current direction. An additional 4,000 trees will be planted to vary the age class from last season's planting. 1000 black cottonwoods, 1000 western redcedar, 1000 spruce and 500 red osier dogwoods will be planted.

Mineral Creek

Reach 1

One single-wing deflector will be constructed in three separate riffle transects. These structures will help to divert flow into relatively stable portions of the stream bank and direct meanders.

Reach 3

Two sets of three boulder placements will be constructed in three separate riffle/run transects. These structures will provide overhead cover, resting areas in the pocket water behind the boulders and some additional scouring.

Indian Creek

Reach 3

Six double-wing deflectors will be constructed. These structures will provide overhead cover, narrow the channel and scour the streambed.

Reach 4

Three log weirs will be constructed in three separate riffle transects to create scour pools. In addition, one single-wing deflector will be constructed in three separate riffle transects to direct meanders. These may also create a scour pool with spawning gravels in the tailout.

Biological objectives

The overall biological objectives were established to provide production goals for all of the Box Canyon Reach tributaries, as adopted by the NWPPC. Monitoring and evaluation of each individual project tributary will determine the need for modification of these objectives. Through these adaptive management strategies biological objectives that are more suitable for these tributaries may be established at a later date.

Biological objective 1

Attain densities (all age classes) of 9.8 bull trout/100m^2 (or 390 fish /linear mile) age class in the upper one third of each major tributary system. This equates to 97,410 bull trout (all age classes) in approximately 250 miles of suitable tributary habitat in the system. Total numbers of adult bull trout recruited to the fishery will be 4,410 fish, composed of an escapement of 2.205 and harvest of 2,205 fish, by the year 2016.

Biological objective 2

Interim bull trout targets are established at 48,855 total fish (all age classes), including a total of 2,205 fish recruited to the fishery, composed of an escapement of 1,102 fish and a harvest of 1,103 fish, by the year 2006.

Biological objective 3

Attain population of 242,2 12 adult cutthroat in 500 miles of suitable cutthroat habitat in the system, including an escapement of 156,800 fish and harvest of 85,412 fish by the year 2016.

Biological objective 4

Interim cutthroat targets are established at 121,106 total adults recruited to the fishery, composed of an escapement of 78,400 fish and harvest of 42,706 fish by the year 2006.

Biological objective 5

Increase the biomass of harvestable largemouth bass in the Box Canyon Reservoir from current 6 pounds/acre (44,400 pounds for the entire reservoir) to an interim target of 8 pounds/acre (59,200 pounds for the entire reservoir) by 2003 and final target of 12 pounds/acre (88,800 for the entire reservoir) by2008 The interim net gain will be 14,800 pounds of harvestable largemouth bass. The final net gain will be 44,400 pounds **Of** harvestable bass.

Biological objective 6

Increase 0+ largemouth bass overwinter survival from current levels of 0.4 – 3.9 percent to approximately 15 – 20 percent. This increase in overwinter survival will contribute to the goal of 12 pounds/acre of harvestable bass.

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